COTTAGER'S SELF HELP PROGRAM

ENRICHMENT STATUS OF LAKES IN THE SOUTHEASTERN REGION OF ONTARIO

1981

Ministry
of the
Environment
Ontario

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Technical Support Section

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ABSTRACT

The many thousands of lakes scattered throughout the vacation areas of our Province are a priceless heritage. No two of them are exactly alike. Some are deep and clear while others are naturally shallow and weedy. Some lakes, however, may become enriched with nuisance growths of weeds and algae as a result of excessive nutrient inputs from developmental and other land use activities within their watersheds.

In 1970, the Ministry of the Environment undertook to inventory the nutrient enrichment (trophic) conditions of recreational lakes in Ontario. This undertaking has been greatly assisted by members of the public who volunteer their time to take water clarity measurements and collect water samples for determination of their algae content as refledted by chlorophyll concentrations from lakes on which they are situated; hence the name Self Help Program.

This report presents data collected from lakes in the Southeastern Region of Ontario by Self Help Program participants during 1981. In general most of our lakes are in very good condition from a recreational point of view. For a few lakes, however, the results indicated that there is a sufficient abundance of algae present to restrict recreational use.

A noticeable improvement in water quality has been documented in Moira Lake following improved treatment of municipal sewage from the Village of Madoc in 1973. A spontaneous return to a lower chlorophyll level was documented in Mackie Lake after several years of progressively increasing concentrations. A separate study by the Ministry of Environment found that no water quality deterioration had taken place in Mackie Lake, despite the rise in chlorophyll.

Many lakes have now been included in the Self Help Program for a number of years and a meaningful data base is beginning to be developed. It is apparent that although algae growth is related to nutrient input, it also varies in intensity seasonally in some lakes and varies annually

with climatic conditions and other factors. These variations will be understood only with the long term data now being accumulated.

The report contains a section entitled "Protection of the Lake" which provides advice to cottagers to minimize their impact on lakes.

ACKNOWLEDGEMENT

The author of this report, D.L. Galloway, greatfully acknowledges the assistance of the numerous cottagers, lakeside residents, staff of the Ministry of Natural Resources and the Ministry of the Environment, and the staff and students of Sharbot Lake High School who volunteered their time to undertake water clarity readings and water sampling for the Self Help Program. Their efforts represent a significant contribution to the understanding of water quality variables in the recreational lakes of our province.

INTRODUCTION

Ontario borders on four of five great lakes and has some 250,000 inland lakes. These lakes represent one of our most valuable resources. A general increase in leisure time, growing affluence, and the ready accessibility of the lakes in vacation areas of southern Ontario to urban centres of population has culminated in the extensive development of their shorelines with summer cottages. In addition, many thousands of tourists and vacationers spend weekends and holidays at waterfront resorts and campgrounds.

Unfortunately, increased development and activity within the watershed of a lake can result in changes to the lake itself. The most common of these changes is an increase in the rate of supply of plant nutrients, principally phosphorus and nitrogen, to the aquatic environment. These nutrients are fertilizers. They result in accelerated growth and increased abundance of algae and other aquatic plants. Algae are single celled, mostly microscopic, green plants. They convert the radiant energy of sunlight by the process of photosynthesis to the chemical energy of plant tissue which serves as a nutritional base for organisms which feed in and on the lake. This is referred to as primary production. Increased primary production gives rise to increased productivity at all levels of the food chain up to and including fish. The overall increase in the productivity of a lake by the nutrient enrichment of its water is scientifically referred to as eutrophication.

A certain amount of nutrient enrichment is beneficial. Aquatic plants and algae provide food and shelter for fish and their prey. The practice of fertilizing lakes and ponds to increase production is an integral part of artificial fish culture. However, the symptons of advancing eutrophication generally spell a decline in the aesthetic, recreational and ecological attractiveness of a body of water.

Excessive growths of rooted aquatic weeds blanket the bottom of shallow regions and interfere with their use for swimming and boating, while increasing concentrations of algae in the water cause a lake to become

progressively more turbid with a corresponding reduction in water clarity. Dead and dying algae settle to the bottom of the lake where they are broken down by bacterial decomposition and decay. The decomposition process utilizes oxygen. In the bottom water of a lake where there is insufficient light penetration to sustain photosynthesis, the oxygen that is used up is not replenished. This results in reduced levels of oxygen in the bottom waters. Bottom water dissolved oxygen depletion is a completely natural process in many lakes and generally does not affect the recreational quality of their surface waters. However, if species of fish such as lake trout, whitefish, herring and other aquatic life that require deep cold water are present, they may not be able to survive in a lake that completely loses its bottom water oxygen supply over a number of years.

One of the more detrimental effects of eutrophication in Ontario is thought to be damage to lake trout fisheries. There are 122 lake trout lakes in the Southeastern Region. According to historical records, lake trout formerly occurred, but now are extinct, in at least 24 other lakes. There are, of course, other factors besides water quality that affect fish populations. These include angling pressure, water level fluctuations, the presence of adequate spawning and nursery areas, predation,disease and parasitisism. Other non-nutrient related water quality problems such as acidification can also occur in some lakes.

Of the two nutrients, phosphorus and nitrogen, that are primarily responsible for eutrophication, phosphorus is the more important. Phosphorus is present in lakes naturally, but its levels may be influenced by man. Lakes receive phosphorus by surface runoff from their surrounding land area and from the atmosphere by precipitation directly on the lake surface. The disturbance of vegetative cover and exposure of soil in the watershed to the errosive forces of wind and rain by natural events such as forest fires and by human activity such as agriculture and development accelerates the export of phosphorus from the land to the lake. The application of fertilizer to crop lands and

lawns results in nutrient loadings to water courses and lakes well above normal rates. Seepage of leachate from improperly located or malfunctioning septic tank tile fields is suspected of contributing significant quantities of phosphorus to some heavily cottaged lakes.

Lakes vary greatly in their sensitivity to nutrient inputs. The response of a lake depends not only on the rate at which nutrients such as phosphorus are supplied, but also on its size, depth, shape and the rate at which its waters are renewed. Large deep lakes and lakes which exchange the entire volume of their water several times a year are not as sensitive to nutrient inputs as small head water lakes which may have a tendency to accumulate the nutrients they receive.

Lakes are classified according to their biological productivity on a continually rising trophic (nutrient enrichment) scale. Those at the nutrient poor end of the scale are oligotrophic lakes. These are typically deep lakes with sandy or rocky bottoms and crystal clear water. At the nutrient rich end of the scale are eutrophic lakes. These lakes are shallow and muddy with weedy shores and often experience seasonal algal blooms. Mesotrophic lakes occupy an intermediate position between these two extremes. They are intermediate with respect to their nutrient concentrations, depth, biological productivity and water clarity. Eutrophic and oligotrophic lakes are represented in stylized cross sections in Figure 1.

The entire range of lake types and water quality conditions are found naturally in Southeastern Ontario.

In the past decade, however, concern has been expressed that culturally induced eutrophication as a result of artificial phosphorus input from cottage and other watershed developmental activity is threatening lake trout habitat in some lakes and resulting in water quality deterioration in others. In 1970 the Ministry of the Environment introduced a

recreational lake survey program to inventory and monitor the water quality of the province's inland lakes. Out of the recreational lakes survey program evolved the SELF HELP PROGRAM which enlists the support of cottage associations, individual cottagers and other concerned public on a volunteer basis to assess the trophic or water quality status of their lakes on a continuing basis.

This report presents water quality data for 92 lakes enrolled in the Self Help Program in the Southeastern Region of Ontario during 1981 and allows an evaluation of the trophic status of 68 of these lakes for which data was obtained on at least 6 or more occasions during the season. The Southeastern Region includes Hastings, Prince Edward and Renfrew Counties and extends eastward to the Quebec border.

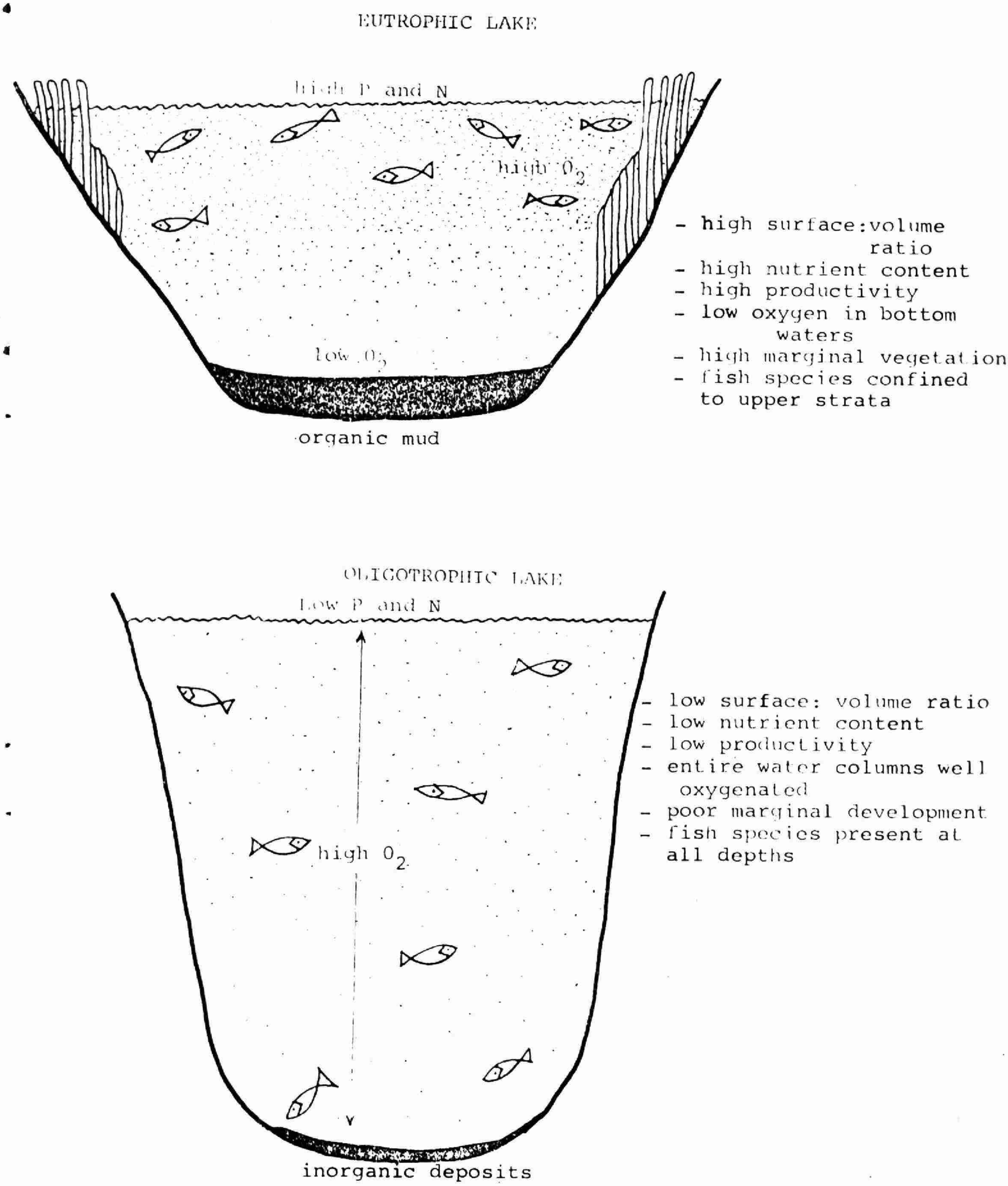

Figure 1. Two principal lake types in stylized cross sections. Relative algal concentrations in the lakes are indicated by stippling.

METHODS

Water clarity is one of the most important characteristics of a lake from a recreational point of view. Secchi disc visibility depth is one of the simplest and most commonly made measurements of water quality. A Secchi disc is a circular steel plate 20 centimetres (8 inches) in diameter painted in opposing black and white quadrants (Figure 2). The depth at which it disappears from view when lowered vertically into the water is a measure of the water clarity of a lake.

Water clarity is affected by the amount of phytoplankton (microscopic algae which inhabit the water of lake). Increasing amounts of phytoplankton in a lake causes the water to become progressively more turbid and water clarity declines as a result. The amount of algae in a unit of water may be determined by placing an aliquot under a microscope and enumerating the individual cells or algal colonies present. This is a time consuming, tedious procedure and requires special collecting and concentrating techniques. A simpler method is to chemically measure the amount of green pigment, chlorophyll a, in the water. Chlorophyll a is a component of all green plants. The amount of chlorophyll a in a sample of water is a measure of the amount of phytoplankton in the lake at the time of sampling.

Volunteers who contacted the Ministry of the Environment to assist in a Self Help Program were provided with a Secchi disc, a water sampling device, bottles, detailed sampling instructions and return shipping material. Samplers were instructed to undertake water clarity measurements at a central or open water location on their lake at weekly or bi-weekly intervals during the ice free season, depending upon their availability at the lake.

The depth at which algae cease to grow in a lake owing to insufficient light to sustain photosynthesis is approximated by twice the Secchi disc depth visibility. Water samples were collected at the same time as water clarity measurements by lowering a narrow mouthed 1 litre bottle

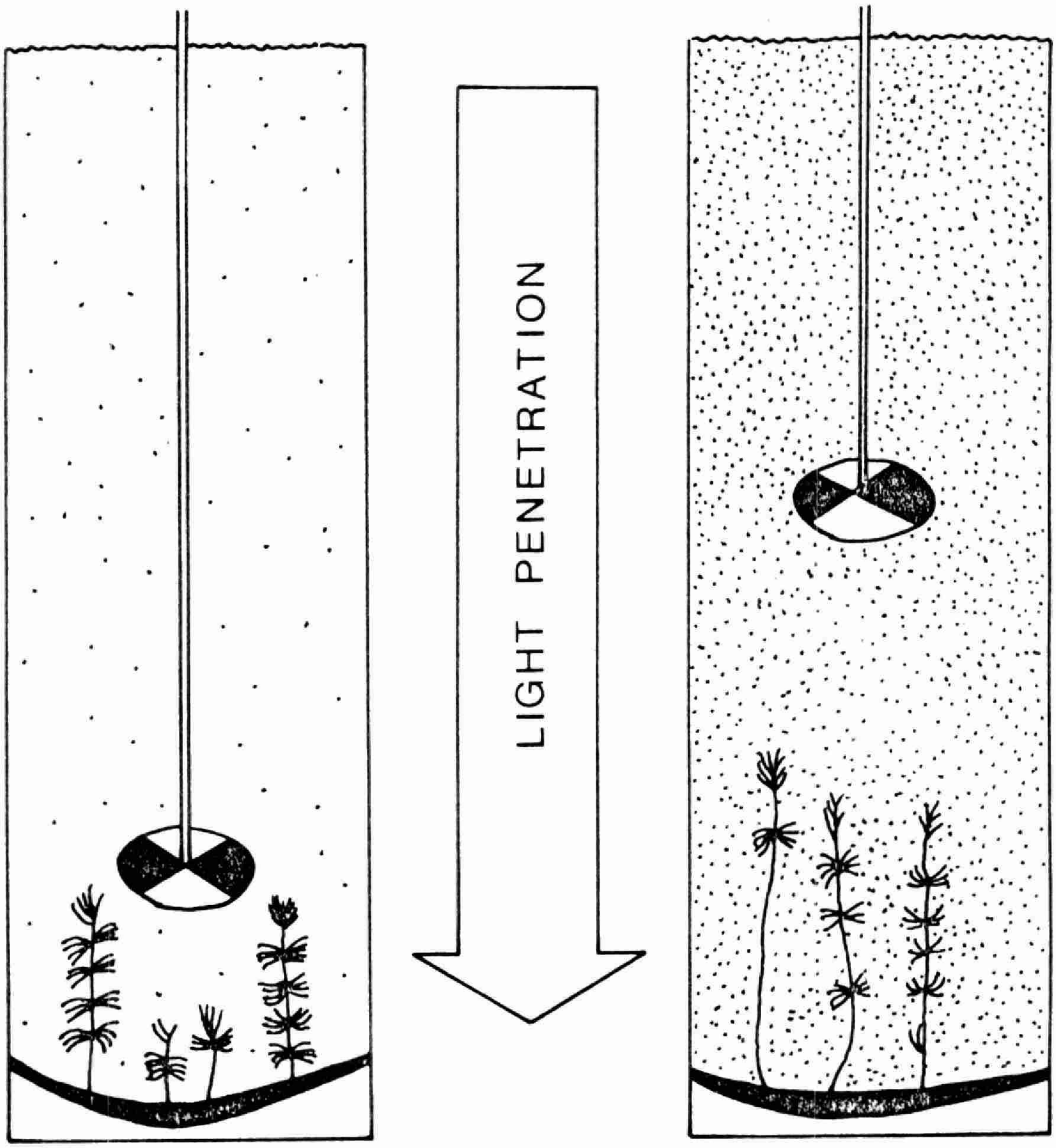

Figure 2. Diagram illustrating the use of a Secchi disc to measure water clarity. Greater visibility characterizes clear lakes having low algal densities (left panel) than productive lakes which contain high algal levels and have low light penetration (right panel).

in a weighted sampler to the lower limit of the zone of phytoplankton growth as determined by doubling the Secchi disc depth measurement. The speed of lowering and raising the sampler was regulated by trial and error repetition so that the bottle just filled as it ascended to the surface. In this manner, a composite sample equally representative of all depths from the measured water column was collected. The samples were preserved immediately after collection with 0.5 ml (5 drops) of one half percent magnesium carbonate suspension to minimize degradation of chlorophyll pigment and were delivered as soon as possible, usually within a day or two, to a Ministry of the Environment Laboratory via COD shipment.

Water samples were filtered using 1.2 micron filter paper, the residue extracted with 90 percent acetone and the chlorophyll concentration determined spectrophotometrically according to standard methods of the Ministry of the Environment Laboratory Services Branch.

Table 1: Lakes in the Southeastern Region of Ontario that were sampled in 1981 for the Cottager's Self-Help Program.

LAKE	COUNTY(S)	TOWNSHIPS
1. Albion	Hastings	Faraday
2. Ashby	Lennox & Addington	Ashby
3. Bagot Long	Renfrew	Bagot
4. Baptiste	Hastings	Herschel
5. Bark	Renfrew, Hastings Nipissing District	Jones, Bangor, Lyell, Wicklow
6. Bass	Leeds	Rear of Leeds & Lansdowne
7. Beaver	Frontenac	Olden
8. Beaver	Lennox & Addington	Sheffield
9. Bennett	Lanark	Bathurst
10. Big Clear	Frontenac	Kennebec
11. Black	Frontenac	Olden
12. Bobs	Frontenac	Bedford
13. Boulter	Hastings	McClure
14. Brule (Wensley)	Frontenac	Miller
15. Buck - North Bay	Frontenac	Loughborough, Bedford, Storrington
16. Buckshot	Frontenac	Miller
17. Burridge	Frontenac	Bedford
18. Carson	Renfrew	Jones, Sherwood
19. Cashel	Hastings	Cashel
20. Charleston	Leeds	Rear of Yonge & Escott, Rear of Leeds & Lansdowne
21. Chippego	Frontenac	Hinchinbrooke
22. Christie	Lanark	Sherbrooke, Bathurst

LAKE	COUNTY(S)	TOWNSHIPS
23. Clayton	Lanark	Ramsay, Lanark
24. Clear, Lake	Renfrew	Sebastopol
25. Clyde	Lanark	Lavant
26. Colton	Renfrew	Admaston
27. Constan (Constant)	Renfrew	Grattan
28. Cranberry	Frontenac	Storrington
29. Crosby	Leeds	North Crosby
30. Crow	Frontenac	Oso, Bedford
31. Crowe	Hastings, Peterborough	Marmora, Belmont
32. Dalhousie	Lanark	Dalhousie
33. Desert	Frontenac	Loughborough
34. Devil	Frontenac	Bedford
35. Diamond	Hastings	Herschel
36. Dickey	Hastings	Lake
37. Dore	Renfrew	Wilberforce
38. Eagle	Frontenac	Hinchinbrooke
39. Farren (Farrell)	Lanark	South Sherbrooke
40. Fifth Depot	Frontenac	Hinchinbrooke
41. Flower Round	Lanark	Lavant
42. Gananoque	Leeds	Rear of Leeds & Lansdowne Front of Leeds & Lansdowne
43. Glanmire	Hastings	Tudor
44. Golden	Renfrew	North Algona
45. Green	Renfrew	Brougham
46. Grippen	Leeds	Rear of Leeds & Lansdowne

LAKE	COUNTY(S)	TOWNSHIPS
47. Gunter	Hastings	Cashel
48. Hambly (Silver)	Frontenac	Portland
49. Hay Bay	Lennox & Addington	Fredericksburgh
50. Hungry	Frontenac	Olden
51. Joeperry	Lennox & Addington	Effingham
52. Kennebec	Frontenac	Kennebec
53. Limerick	Hastings	Limerick
54. Loughborough	Frontenac	Storrington, Loughborough
55. Lower Beverly	Leeds	South Crosby, Bastard
56. Mackie	Frontenac	Miller
57. Mazinaw	Frontenac Lennox & Addington	Abinger, Barrie
58. Mephisto	Hastings	Cashel
59. Miller	Frontenac	Palmerston
60. Mink	Renfrew	Wilberforce
61. Mississippi	Lanark	Drummond, Beckwith, Ramsay
62. Moira	Hastings	Huntington
63. Mosque	Frontenac	Miller, Clarendon
64. Mud	Frontenac	
65. Muskrat	Renfrew	Westmeath, Ross
66. Newboro	Leeds	North Crosby, South Crosby
67. Norway	Renfrew	Bagot
68. Olmsted (Jefferys)	Renfrew	Ross
69. Opinicon	Frontenac, Leeds	Bedford, Storrington, South Crosby
70. Otter	Leeds	Bastard, South Elmsley

LAKE	COUNTY(S)	TOWNSHIPS
71. Otty	Lanark	North Burgess, North Elmsley
72. Palmerston	Frontenac	Palmerston, South Canonto
73. Paugh	Renfrew	Burns, Sherwood
74. Pike	Lanark, Leeds	North Burgess,North Crosby
75. Potspoon	Frontenac	Bedford
76. Red Horse	Leeds	Rear of Leeds & Lansdowne
77. Robertson	Lanark	Lavant
78. St. Andrews	Frontenac	Hinchinbrocke
79. Salmon Trout	Hastings	Monteagle
80. Shabomeka	Frontenac	Barrie
81. Sharbot	Frontenac	Olden
82. Silver	Frontenac, Lanark	Oso, South Sherbrooke
83. Smith	Renfrew	Head
84. Spring	Frontenac	Portland
85. Spruce	Frontenac	Kennebec
86. Sunday	Frontenac	Palmerston
87. Troy	Leeds	South Crosby
88. Twin Sisters	Hastings	Marmora
89. Verona (Rock)	Frontenac	Portland
90. Wallbridge	Frontenac	Kennebec
91. White	Lanark, Renfrew	Darling, Bagot & McNab
92. Wollaston	Hastings	Wollaston

RESULTS AND DISCUSSION

Ninety-two lakes were enrolled in the 1981 program (Table 1). The enrollment consisted of 14 "new lakes" and 78 that were carried over from the program in 1980 or earlier. The lakes ranged in size from less than 10 hectares to 3,800 hectares. The range of other physical characteristics, shape, depth, water renewal rate, and so on also vary greatly. Lakes were scattered throughout Southeastern Ontario with the majority located within the Precambrian shield, a geological formation that embraces the northern two-thirds of the region and in the form of a southward extension, the Frontenac Axis, passes through the Kingston-Gananoque area.

The mean Secchi disc visibility depths and mean chlorophyll concentrations for 68 lakes (72 basins) with 6 or more sets of measurements each are summarized in Table 2. Individual results for each sampling date for all 92 lakes are presented in Table 4. Some lakes are represented by more than one sampling site. This is necessary for lakes divided into two or more distinct basins (Loughborough, Sharbot) or that are comprised of a number of bays (Bobs, Mosque) which may act independently from a water quality point of view, and is desireable for large or irregularly shaped lakes (Desert) where spatial differences in water clarity and phytoplankton density might be expected to occur.

The results indicate that algae growths vary in intensity in some lakes in different seasons of the year. Colton, Eagle, and Grippen for example, attained their highest chlorophyll concentrations during spring and early summer while some other lakes such as Pike experienced their maximum productivity and poorest water clarity later in the year.

Table 2: Means for Secchi disc visibility depths (metres) and chlorophyll concentrations (micrograms per litre) for 68 lakes (72 basins) with 6 or more sets of data in the Southeastern Region of Ontario during 1981. Number of measurements used in the derivation of the means is also presented. When a different number of Secchi and chlorophyll measurements were available, the number of Secchi measurements is presented first.

LAKE		Secchi (m)	Chloro. (ug/1)	No. of Samples
2.	Ashby	5.6	1.2	11
4.	Baptiste	4.0	2.6	11
5.	Bark	4.1	1.3	9
6.	Bass	5.9	1.7	12,10
8.	Beaver	3.6	1.7	13
11.	Black	5.1	1.7	6
12.	Bobs			
	Buck Bay	5.4	2.3	6
	Eastern Basin /Long Bay	3.8	1.1	20
	Mud Bay	2.9	4.0	10
	Western Basin	3.2	3.6	6
14.	Brule	7.3	1.2	12
15.	Buck	4.2	2.7	34,33
	North Bay			
17.	Burridge	4.4	1.7	20
18.	Carson	5.8	1.4	10
19.	Cashel	5.7	1.8	6
20.	Charleston	2.7	3.9	62,60
21.	Chippego	3.2	3.7	21
22.	Christie	3.4	3.2	6
23.	Clayton	3.7	3.0	10
26.	Colton	6.6	1.2	12
27.	Constan	4.5	1.6	12
28.	Cranberry	2.7	4.7	8
29.	Crosby	4.4	2.5	13
30.	Crow	4.2	0.7	12
31.	Crowe	2.9	2.0	14
32.	Dalhousie	5.1	1.3	16
33.	Desert	4.6	2.3	19
34.	Devil	5.0	2.9	20,18
35.	Diamond	5.3	1.0	6
36.	Dickey	5.3	1.3	26
37.	Dore	4.7	2.4	6
38.	Eagle	4.6	2.1	29
39.	Farren	5.7	1.6	20
40.	Fifth Depot	3.4	3.5	6
42.	Gananoque	3.7	4.6	12
43.	Glanmire	2.8	6.1	6

LAKE		Secchi (m)	Chloro. (ug/1	No. of Samples
45.	Green	9.8	1.5	8
46.	Grippen	2.9	5.9	12
47.	Gunter	4.3	2.5	16
49.	Hay Bay	1.4	14.2	16
51.	Joeperry	5.6	1.7	5,6
52.	Kennebec	3.2	2.2	27
54.	Loughborough			
	a) East Basin	2.9	4.9	11
	b) West Basin	6.8	2.7	6,5
55.	Lower Beverly	2.2	6.4	8,7
56.	Mackie	6.1	2.3	7
57.	Mazinaw	4.9	1.2	8,9
60.	Mink	3.0	2.5	6
61.	Mississippi	2.5	4.7	24,22
62.	Moira			
	East Basin	3.1	5.1	7
63.	Mosque	5.2	1.7	22,21
65.	Muskrat	1.6	19.6	13
66.	Newboro	2.7	4.5	8,7
68.	Olmsted	5.7	2.0	10
69.	Opinicon	3.2	3.1	26
70.	Otter	2.9	2.2	21
71.	Otty	3.9	2.2	19,20
72.	Palmerston	8.0	1.2	12
73.	Paugh	5.3	1.3	10
74.	Pike	3.7	3.6	18
75.	Potspoon	4.2	1.7	12
76.	Red Horse	3.4	5.0	11
77.	Robertson	6.7	1.0	9
78.	St.Andrews	1.7	8.2	12
79.	Salmon Trout	3.5	3.7	8,6
80.	Shabomeka	4.4	2.1	6
81.	Sharbot			
	West Basin	4.7	2.1	6
82.	Silver	3.6	2.0	18,17
83.	Smith	4.1	3.2	9
87.	Troy	2.3	4.2	19
88.	Twin Sister			
	West Basin	4.4	1.9	10
91.	White	2.8	3.9	35,33

Since the frequency and regularity of sampling can thus affect mean chlorophyll concentrations and mean Secchi disc visibility depths, discretion is required in comparing some lakes. In a number of cases, sampling was completed during the summer months only, and the presence or absence of higher phytoplankton levels and reduced water clarity during the spring and fall cannot be confirmed. No attempt at all should be made to define the nutrient enrichment status of lakes for which less than six sets of measurements were completed. These lakes are omitted from Table 2 and from the remainder of the report for comparative purposes.

Mean Secchi disc visibilities ranged from 1.4 metres (Hay Bay) to an exceptionally clear 9.8 metres (Green Lake) with an overall average value of 4.3 metres.

For reasons of safety water in swimming areas should have a minimum transparency of 1.2 metres (4 feet) to ensure that submerged objects are visible, although better water clarity is certainly desireable. Most of the lakes had Secchi depths greater than 3 metres.

Since penetration of light is affected by the amount of phytoplankton in the water, a good co-relation exists btween chlorophyll concentrations which reflect the abundance of phytoplankton and Secchi disc readings which are measures of the optical properties of the lakes. The curve in Figure 3 represents this relationship for the lakes included in the 1981 Self-Help program. Lakes with low levels of chlorophyll and very high water clarity, Green, Palmerston, Brule, Colton, Loughborough, Robertson and Mackie are situated near the vertical arm in the upper left area of the graph. Lakes with elevated chlorophyll concentrations and reduced water clarity, Lower Beverly, St. Andrews, Hay Bay, and Muskrat, lie along the horizontal arm in the lower right area. Most lakes, which are intermediate between these extremes of exceptional transparency and elevated chlorophyll concentration are clustered about the mid section of the curve.

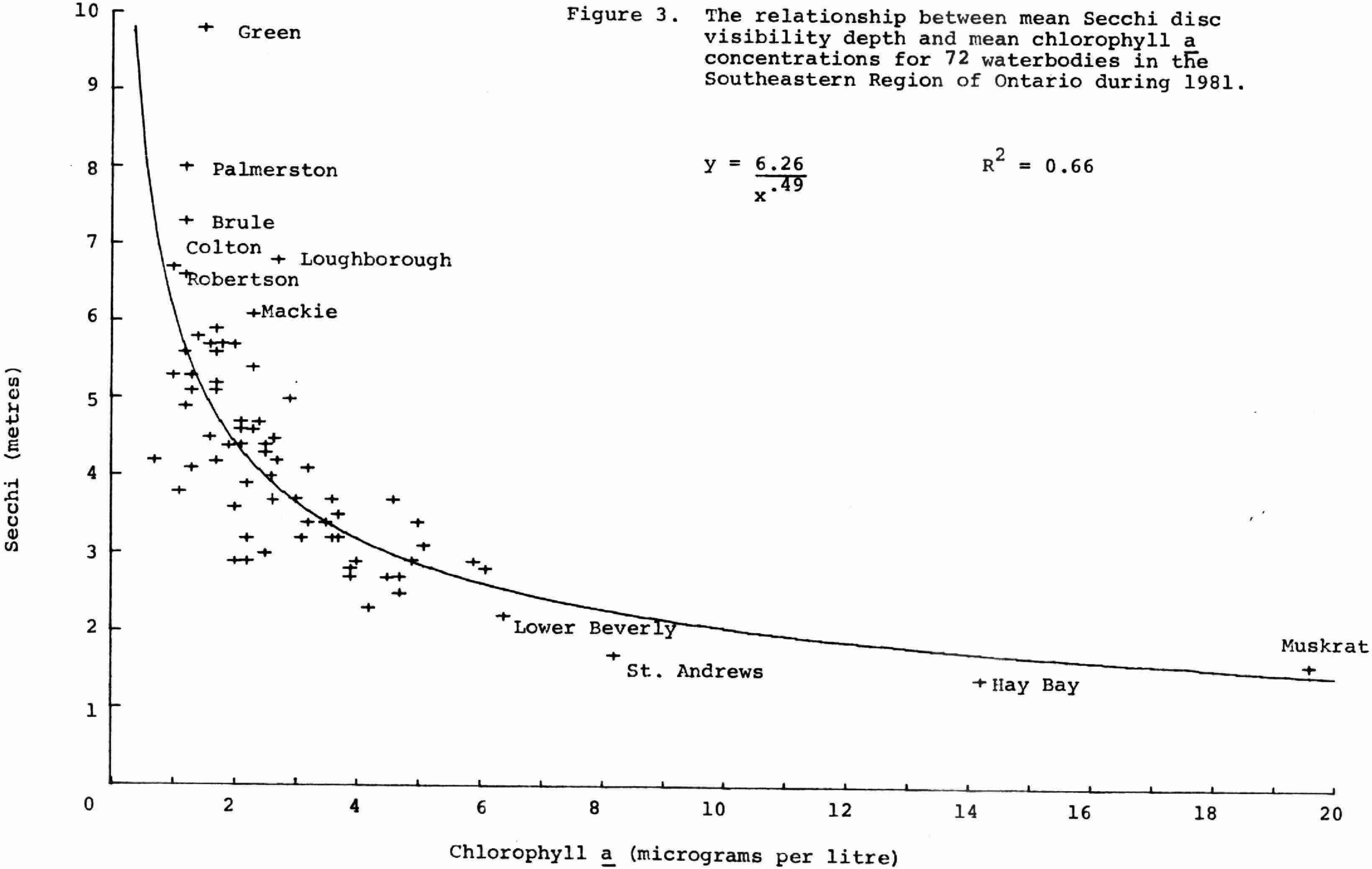

Figure 3. The relationship between mean Secchi disc visibility depth and mean chlorophyll a concentrations for 72 waterbodies in the Southeastern Region of Ontario during 1981.

Numeric criteria are useful to define a trophic classification scheme. These typically involve total phosphorus concentrations, total nitrogen concentrations, chlorophyll concentrations, Secchi disc depths and/or other water quality parameters. Chlorophyll concentrations, since they are regulated by a combination of physical, chemical and biological factors are widely accepted as one of the more integrative indices of trophic state. Since changes from oligotrophy to eutrophy do not occur at sharply defined stages, divisions in trophic level are by necessity somewhat arbritrary and possibly of limited geographic applicability.

A Ministry of Environment trophic state - chlorophyll a classification scheme is presented below in comparison with criteria used by the United State Environmental Protection Agency and the United States National Academy of Science.

Trophic Condition vs. Chlorophyll a

Trophic State	Chlorophyll a (ug/l)		
	Ontario Ministry of Environment	National Academy of Science	U.S. Environmental Protection Agency
Oligotrophic	0-2	0- 4	L7
Mesotrophic	2-4	4-10	7-12
Eutrophic	G4	G10	G12

G = greater than

Seasonal mean chlorophyll concentrations of lakes in the Self-Help program ranged from 1.0 ug/l (Diamond, Robertson) to 19.6 ug/l.(Muskrat) and thus encompass the entire range of trophic conditions normally encountered. None, however, approach the extremely enriched conditions, for example in certain small Canadian Prairie sloughs which commonly

attain chlorophyll concentrations of 100-400 ug/l. Based on even the most stringent trophic scheme criteria, most our lakes may be regarded as either oligotrophic or mesotrophic.

In terms of practical significance, lakes with chlorophyll concentrations less than 5 ug/l are considered to have water quality conditions suitable for a diversity of recreational pursuits including water contact sports such as swimming and bathing. Seasonal mean concentrations greater than 10 ug/l likely reflect the occurrence of occasional algae "blooms". A bloom is an explosion in the numbers of algae. This occurs as a result of their rapid proliferation under extremely favourable growing conditions of luxuriant nutrient availability and a prolonged period of warm, calm and sunny weather. Blooms are visually apparent by imparting a green, blue-green or brownish tinge to the water. Under bloom conditions the recreational and aesthetic attractiveness of the lake may be greatly diminished for lake oriented activities. Blooms may also result in taste and odour problems and cause filter clogging in domestic supply systems that draw upon the lake as a source of water. Higher levels of algae also make it difficult for some types of fish to survive and result in a shift to less desireable species from an angling point of view.

Concentrations greater than 15 to 20 ug/l as a seasonal mean indicate the frequency and severity of extremely high phytoplankton levels, measured as chlorophyll, are sufficiently problematic to chronically interfere with most beneficial uses of the lake. This is the situation in Hay Bay and Muskrat Lake as confirmed by complaints about water quality in these two water bodies. Based on an evaluation of their nutrient (phosphorus) budgets it appears that the productivity of these two basins is attributable to agricultural runoff from the naturally fertile land that constitutes their watersheds, and is therefore largely an intractable problem at present.

Some 65 lakes now have three or more consecutive years data collected through the Self-Help program (Table 3). This allows a comparison of water clarity and phytoplankton abundance between years within the

lakes. Just as there is considerable variation in Secchi disc depths and chlorophyll concentrations within any one year, there is considerable annual variation as well. Annual variation can be due to cultural acitivities within the watershed that significantly alter the nutrient loadings of the lake, for example, shoreline development, large scale changes in forestry or agricultural operations or improvements to sewage disposal practices.

A case in point is Moira Lake. The Village of Madoc (population 1,240) indirectly discharges municipal sewage to Moira Lake via Deer Creek. As part of a provincial policy to reduce nutrient inputs to Ontario's lakes & rivers, seasonal retention and phosphorus removal facilities became operational in Madoc in 1973. The lagoons are only discharged in the spring and fall when there is adequate stream dilution and, respectively, before or the after the growing season for aquatic plants. Seasonal mean chlorophyll concentrations have declined from the value of 26 ug/l measured in 1972 and have been accompanied by a corresponding improvement in water quality. The situation in Moira Lake parallels similar improvements in water quality that have been observed in the lower Great Lakes and in the Bay of Quinte as a result of municipal pollution controls implemented during the past decade.

In Mackie Lake the Self Help program revealed an apparent increase in chlorophyll concentrations between 1976 and 1980 in the absence of any watershed perturbation. Owing to the persistancy and and magnitude of the trend towards increasing chlorophll concentrations, the Ministry of Environment untook a separate study of Mackie Lake in 1980, as recommended in that years Self Help program report. Although the results of the survey confirmed chlorophyll concentrations were apparently higher than previously documented, other parameters did not indicate any deterioration in water quality had occurred. In particular the result of microsopical examination of a series of water samples collected through the euphotic zone was a mean biovolume of algae of 272 u^3/l, well within the realm of oligotrophy for this parameter. It is noted that in 1981 chlorophyll concentrations and Secchi values

measured by the Self-Help program were more typical of historical values in Mackie Lake.

In most other cases the year to year variations in Secchi disc depths and chlorophyll concentrations are relatively minor and can likely by attributed to year to year variations in climatic conditions and other natural factors.

Table 3: Mean values for Secchi disc visibility depths (metres) and chlorophyll a concentrations (micrograms per litre) for lakes in the Southeastern Region of Ontario with three or more years of 6 sets of measurements each available.

LAKE	1981		1980		1979		1978		1977		1976		1975		1974		1973		1972	
	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.
Adams							4.3	3.9	3.9	3.2	4.1	3.4								
Ashby	5.6	1.2	5.9	1.7	5.6	1.4	6.4	1.5	6.8	1.3										
Baptiste	4.0	2.6	3.5	3.0	4.5	1.8	4.3	1.6	3.6	2.4			3.2	2.1						
Bass	5.9	1.7	6.5	2.1	4.7	1.7	5.9	1.5	6.6	1.0										
Big Gull							4.6	2.0	4.6	2.0	4.6	2.1								
Big Rideau					4.4	2.3	4.5	2.0	4.0	1.4	4.1	2.3	4.5	1.6						
Black	5.1	1.7	4.7	2.1	5.2	1.5	4.9	1.6	5.0	1.3	4.1	1.4								
Bobs - Buck Bay	5.4	2.3	3.7	4.5	3.6	3.3	3.4	3.0	3.8	3.5	4.8	2.6								
- Mud Bay	2.9	4.0	3.5	4.9							3.5	4.0								
- West Basin	3.2	3.6	3.6	3.3							3.4	2.6								
Boulter							4.0	1.4	4.0	1.0	3.7	1.5								
Buck - North Bay	4.1	2.4	3.8	3.1	3.5	4.0	3.9	3.3	3.5	2.3										
Carson	5.8	1.4	5.3	2.0	5.7	1.8	6.2	1.9	6.3	1.3										
Charleston	2.7	3.9	4.3	2.5	3.9	2.5	3.8	2.4	4.0	2.2	4.9	2.9								
Christie	3.4	3.2	4.7	3.3	4.4	4.1	4.8	2.8	4.4	3.9	4.3	2.8								
Clear					4.2	2.4	4.2	1.7			3.5	1.8								
Collins Bay			2.8	5.4	3.0	6.4	3.2	4.1	3.3	3.2	2.8	3.5	2.8	4.2						

LAKE	1981		1980		1979		1978		1977		1976		1975		1974		1973		1972	
	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.
Cranberry	2.7	4.7	2.2	9.4	2.1	9.2	1.6	12.4	2.2	7.6										
Crowe	2.9	2.0	3.0	3.2	2.4	3.2	2.4	2.1	4.8	2.2	4.7	3.3			4.7	1.2			3.8	1.7
Dalhousie	5.1	1.3	4.4	2.8	3.4	1.9	4.6	1.4	4.1	1.6	3.9	2.3								
Desert	4.6	2.3	4.6	2.3	4.5	2.0	5.5	1.7	4.9	1.7										
Devil	5.0	2.9					5.3	1.9	4.8	1.7	5.2	1.5	5.1	2.0	5.7	1.6				
Diamond	5.3	1.0	4.3	1.3	4.9	1.3	5.1	1.0												
Dickey	5.3	1.3															4.5	1.3	4.4	1.4
Dore	4.7	2.4	4.4	3.0	4.7	2.2	4.5	2.5	4.8	2.0										
Eagle	4.6	2.1	4.8	2.9	4.7	2.2			4.3	1.3										
Gananoque	3.7	4.6	1.8	5.3	3.2	3.1	3.0	4.7	2.2	3.1										
Garskeys (Ellens)					3.4	3.0	3.5	3.2	3.5	2.2										
Glanmire	2.8	6.1			3.6	3.4	3.7	3.0	3.4	1.9	3.2	2.3	3.6	---						
Green	9.8	1.5	8.9	1.1	7.9	1.6	8.0	0.8	8.3	0.7	8.5	1.6								
Grippen	2.9	5.9	3.8	4.0	2.9	2.5	3.2	3.1	2.7	2.1	3.9	3.1	2.9	2.6						
Hay Bay	1.4	14.2	1.0	19.9	1.2	16.6	1.5	12.1	1.1	16.6										
Hurds					4.4	2.9	4.5	2.2	4.7	2.1			4.8	1.7						
Joeperry	5.6	1.7			3.8	2.5	4.2	2.5	4.3	1.6										
Kamaniskeg			4.8	2.5	4.5	1.7	4.6	2.2	5.1	1.4	4.5	1.2								
Kennebec	3.2	2.2	2.4	5.5	3.2	2.4	3.5	2.2	3.7	1.9	4.1	2.7								

LAKE	1981		1980		1979		1978		1977		1976		1975		1974		1973		1972	
	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.
Limmerick			4.7	1.5	4.4	1.3	4.7	1.5	4.7	1.0	5.0	1.1								
Little Silver					4.0	4.6	5.1	2.6	4.2	5.0										
Loughborough																				
East Basin	2.9	4.9	3.2	5.1	3.3	3.6	3.0	3.6	2.8	3.7	3.4	2.1	2.3	4.9	2.7	2.7	3.3	--	3.1	2.6
West Basin	6.8	2.7	4.8	2.5	4.0	2.0	3.9	1.8	3.4	2.2	4.5	2.5	4.1	2.1			4.0			
Lower Beverley	2.2	6.4					2.4	3.6	2.4	5.2										
Mackie	6.1	2.3	4.9	4.8	6.7	4.6	6.1	2.5	6.3	1.8	6.0	1.3					6.6	0.5		
Mazinaw	4.7	1.2	4.9	1.4	5.2	1.4	5.6	1.0	5.7	1.2	5.6	1.2	5.6	1.0						
Mink	3.0	2.5	4.1	3.5	4.2	1.4	4.3	1.6	3.5	1.5	3.6	1.8	3.8	1.8						
Mississippi	2.5	4.7			3.9	2.1	3.4	1.8							3.6	2.0	4.3	2.2		
Moira																				
West Basin					1.9	6.5							1.6	11.9	1.7	9.3	1.6	10.4	1.1	26.0
East Basin	3.1	5.1					2.0	8.0	2.0	7.2							2.1	9.2		
Mosque																				
N.W. Basin					4.6	3.2	4.5	3.7	3.9	2.9										
Main Basin	5.2	1.7	4.8	1.6	5.5	1.4	5.7	1.5	5.1	2.7										
Muskrat	1.6	19.6			2.4	7.1	2.7	6.6	1.7	10.3										
Olmsted	5.7	2.0	5.4	2.6	6.3	1.2	6.6	1.4												
Opinicon	3.2	3.1	3.2	3.9	3.3	3.7	3.0	3.6	2.8	2.6										

LAKE	1981		1980		1979		1978		1977		1976		1975		1974		1973		1972	
	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.	SD	chl.
Otter	2.9	2.2	2.7	2.3	3.1	2.3	3.3	2.0	3.0	2.1	3.2	2.4	3.2	1.4						
Otty	3.9	2.2	4.5	2.7	4.4	2.1	4.2	2.1	4.0	1.7	4.5	1.8	4.5	1.8	3.8	1.1	4.1	1.9		
Palmerston	8.0	1.2	8.4	1.5	8.8	1.6	8.2	1.4	7.1	1.6										
Pike	3.7	3.6	3.8	4.3	3.7	4.0	4.2	2.8	3.1	4.0	2.4	4.4								
St. Peter			3.2	2.2	3.5	2.0					3.6	1.9								
Salmon Trout	3.5	3.7	3.3	11.7	3.2	7.4	4.2	5.0			3.4	6.6			3.7	1.4				
Sharbot East Basin			3.6	3.2	3.1	2.0	2.8	1.9												
West Basin	4.7	2.1	4.3	2.4	4.4	1.9	4.8	1.8	4.2	1.7	4.1	2.0								
Silver	3.6	2.0	3.4	2.4	4.1	2.0	3.5	1.8	3.5	1.6										
Steenburg					4.5	2.1	4.2	2.0	4.7	2.0	4.3	1.3								
Sydenham			4.2	3.2	3.6	3.0	3.6	2.1	5.0	3.4										
Tait															4.2	4.0	4.1	1.5	5.6	0.9
Temperance			1.9	6.0	2.6	3.1	2.2	2.8	1.2	8.9	1.9	7.7								
Thirty Is.			4.6	3.6	4.6	1.7	5.0	2.2	5.0	2.6										
Troy	2.9	3.9	2.3	6.7	2.0	8.0	1.9	7.4	1.7	6.9										
White	2.8	3.9	2.7	5.3	3.0	3.0	3.2	3.7	2.8	3.6	2.3	6.4	3.1	3.5	3.0	2.2	2.6	4.2	1.8	4.8
Whitefish			2.6	4.3	3.0	2.6	2.7	3.4	2.6	4.4										
Overall Mean			4.05	3.83	4.01	3.24	4.20	2.92	4.05	2.97	4.15	2.65	3.76	2.91	3.68	2.83	3.63	4.27	3.08	7.20

CONCLUSIONS AND RECOMMENDATIONS

The information on water clarity and phytoplankton levels obtained through the cottagers' Self Help Program to date indicate that most of our inland lakes are in excellent condition from a water quality point of view. There are only a few lakes where chlorophyll concentrations are sufficiently high to suggest that excessive amounts of algae or other symptoms of advancing eutrophy might interfere with recreational use. In most cases the productivity of those lakes is largely a reflection of the fertility of the surrounding land area from which they receive drainage and runoff.

It would be desirable to determine if any trends towards advancing or lessening eutrophication were occurring. This would permit an assessment of the effectiveness of corrective measures to reduce nutrient inputs and similarly permit preventive measures such as restrictive land use zoning and other restrictions on shoreline or waterfront development to be imposed as required. Very few lakes have been studied long enough to determine their year to year or perhaps decade to decade variability. With relatively few exceptions, it is difficult to determine if three, five or more consecutive years measurements merely represent fluctuations about a stable long term average condition or whether lakes may perhaps be undergoing a gradual shift in trophic level on a borader scale. Monitoring trophic parameters such as chlorophyll a and Secchi disc depth is the best method to address this problem.

The Ministry of the Environment does not have the fiscal or logistical resources to undertake an extensive surveillance on a continuing basis without volunteer assistance in the aquisition of water samples and field data such as through the Self Help Program.

Participants in the 1981 Self Help Program are therefore requested to consider continuation of their sampling in 1982. The Ministry of the Environment also welcomes inclusion of lakes not presently enrolled in

the Self Help Program. The Self Help Program provides an opportunity not only for an annual assessment of the trophic status of their lake, but also provides an opportunity to educate cottagers and their associations about the causes and effects of eutrophication. For further information and assistance in establishing a Self Help Program, write to: Self Help Program, Ontario Ministry of the Environment, P.O. Box 820, 133 Dalton Street, Kingston, Ontario K7L 4X6, (Telephone 613-549-4000).

PROTECTION OF THE LAKE

Of the few management options available for dealing with water quality problems the most effective is prevention. Nitrogen and phosphorus have been identified as critical elements in eutrophication. The near shore region of a watershed contributes a disproportionate share of phosphorus and nitrogen relative its area because of its proximity to the lake. It is important that cottagers and other waterfront owners do everything possible to ensure that their acitivities do not allow these nutrients to reach the lake. Following is a list of suggestions.

1) New cottage construction and septic systems should be sited well back from the water. This practice allows algae producing nutrients in runoff and seepage from tile beds to be absorbed by soil and vegetation. Set backs have the additional advantage of preserving the scenic beauty of the shore by preventing development from intruding unnaturally on the lake.

2) Site preparation and building activities should disturb the soil and vegetation as little as possible. All areas that are exposed during construction should be replanted as soon as possible to prevent runoff and erosion.

3) Ensure that your sewage disposal system is in compliance with provincial regulations and properly maintained. Septic tanks should be pumped out every three years and the area over a tile bed should be grassed and left open to sun and wind to encourage evapotranspiration. In the Southeastern Region responsibility for regulations pertaining to private waste disposal systems is delegated to local Health Units. If a problem with your system is apparent such as ponding or suspected contact your Health Unit for guidance.

4) Minimize the quantity of water used for domestic purposes to avoid overloading a septic system. Dishwashers and automatic washing

machines use a lot of water. Take your laundry to the city. Moreover, detergents for dishwashers contain a high amount of phosphates which should be avoided for cottage use.

5) If you have a lawn do not fertilize it. Excess fertilizer will wash off into the lake and may promote unwanted nuisance aquatic growths.

6) The shallow near shore or "littoral" zone supports most of the plant and animal life found in a lake. Disruption of any part of of this ecosystem threatens the entire cycle of life in the lake. In particular, habitat for fish and other wildlife may be destroyed. Before undertaking any shoreline activities such as dredging or filling contact the Ministry of Natural Resources for advice. In fact prior approval may be required under the Navigable Waters Protection Act or the Fisheries Act.

Table 4: Secchi disc visibility depths (metres) and chlorophyll a concentrations (micrograms per litre) data collected from 94 lakes in the Southeastern Region of Ontario during the summer of 1981. Mean and standard deviation values are also presented.

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL *a* (ug/l)
1. Albion	Jul 26	3.0	2.7
	Aug 2	3.6	2.1
	Aug 23	4.0	2.4
	Aug 30	3.9	0.7
	MEAN	3.18	2.78
	STANDARD DEVIATION	0.80	0.99
2. Ashby	May 18	5.6	1.3
	Jun 7	5.9	1.4
	Jul 5	5.2	1.7
	Jul 14	4.9	1.7
	Jul 25	5.5	1.0
	Aug 9	7.3	0.8
	Aug 23	5.5	0.7
	Sep 13	3.9	0.9
	Sep 20	5.5	1.3
	Oct 12	6.4	1.1
	Oct 31	5.8	0.9
	MEAN	5.59	1.16
	STANDARD DEVIATION	0.85	0.34
3. Bagot Long	Aug 2	4.9	--
4. Baptiste	Jul 8	4.0	2.5
	Jul 11	2.7	2.9
	Jul 30	3.9	8.6
	Jul 30	4.3	1.2
	Aug 31	4.6	1.4
	Aug 31	4.1	1.6
	Sep 13	4.1	1.9
	Sep 13	3.8	1.7
	Sep 26	4.1	1.6
	Sep 26	4.3	2.5
	Nov 1	3.8	2.2
	MEAN	3.97	2.55
	STANDARD DEVIATION	0.48	2.07
5. Bark	Jun 1	3.7	1.3
	Jun 18	3.4	1.8
	Jul 2	3.4	1.6
	Jul 16	3.3	0.6
	Jul 30	5.2	0.8
	Aug 13	4.7	1.5
	Aug 25	4.6	1.5
	Sep 11	3.9	0.7
	Oct 13	4.7	1.6
	MEAN	4.1	1.27
	STANDARD DEVIATION	0.7	0.45

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
6. Bass	May 31	6.4	2.8
	Jul 19	4.9	1.5
	Jul 26	5.5	1.3
	Aug 3	6.1	1.6
	Aug 9	6.4	1.1
	Aug 30	5.5	--
	Sep 7	6.4	0.8
	Sep 13	6.4	1.7
	Sep 23	4.6	2.8
	Sep 20	6.1	--
	Sep 27	5.8	1.9
	Oct 12	6.7	1.9
	MEAN	5.9	1.74
	STANDARD DEVIATION	0.66	0.66
7. Beaver	Jul 2	3.7	2.0
	Jul 10	4.7	1.0
	Jul 10	4.5	1.4
	MEAN	4.3	1.47
	STANDARD DEVIATION	0.53	0.50
8. Beaver North Basin	Jul 10	4.7	1.0
	Jul 16	4.3	0.9
	Jul 23	4.6	0.6
	Jul 30	3.7	0.5
	Aug 6	3.4	1.8
	Aug 20	3.4	1.6
	MEAN	4.02	1.07
	STANDARD DEVIATION	0.59	0.53
Beaver South Basin	Jul 10	4.6	1.4
	Jul 16	3.0	1.3
	Jul 23	3.4	2.0
	Jul 30	3.0	1.2
	Aug 6	3.4	4.2
	Aug 13	3.0	1.4
	Aug 20	2.7	4.1
	MEAN	3.30	2.23
	STANDARD DEVIATION	0.62	1.34
9. Bennett	Sep 13	5.3	4.2

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL $\underline{a}$ (ug/l)
10. Big Clear Lake	Jun 14	1.3	2.0
	Jul 5	2.6	1.0
	Jul 19	2.6	1.9
	Aug 2	2.4	1.1
	MEAN	2.23	1.5
	STANDARD DEVIATION	0.62	0.52
11. Black Lake	Jun 24	4.9	2.6
	Jul 9	4.9	1.2
	Jul 23	5.3	1.3
	Aug 6	5.5	2.1
	Aug 20	4.6	1.6
	Sep 3	5.2	1.6
	MEAN	5.07	1.73
	STANDARD DEVIATION	0.33	0.53
12. Bobs Buck Bay	May 17	7.0	2.1
	Jun 20	5.3	2.8
	Jun 28	5.3	2.6
	Aug 31	4.9	2.0
	Sep 6	5.5	1.4
	Oct 11	4.3	2.9
	MEAN	5.38	2.3
	STANDARD DEVIATION	0.90	0.57
Bobs East Basin	Aug 8	4.0	--
	Aug 22	5.4	2.0
	Aug 29	4.2	2.8
	Sep 7	4.7	2.8
	Sep 20	3.3	3.2
	Sep 21	3.2	1.6
	Sep 28	2.7	3.4
	Oct 5	2.2	1.9
	Oct 12	2.9	4.0
	MEAN	3.62	2.71
	STANDARD DEVIATION	1.03	0.83

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
Bobs Long Bay	Aug 4	5.9	2.1
	Aug 9	4.3	2.6
	Aug 22	5.3	2.8
	Aug 24	--	2.4
	Aug 30	2.9	2.0
	Sep 6	2.7	3.5
	Sep 6	3.9	1.4
	Sep 13	3.6	4.7
	Oct 11	2.7	4.3
	Oct 16	3.9	4.4
	Oct 17	2.4	3.5
	Oct 31	4.9	3.3
	MEAN	3.86	3.08
	STANDARD DEVIATION	1.15	1.04
Bobs Mill Bay	Aug 2	2.6	--
	Aug 22	2.7	--
	Sep 5	2.6	2.4
	Oct 3	2.7	--
	MEAN	2.65	2.4
	STANDARD DEVIATION	0.06	--
Bobs Mud Bay	Jul 11	4.1	1.0
	Jul 19	3.6	7.0
	Jul 26	2.7	2.0
	Aug 3	3.3	9.1
	Aug 19	3.0	3.1
	Aug 25	3.6	5.8
	Sep 9	2.3	2.8
	Sep 16	2.3	3.2
	Sep 21	1.8	3.2
	Sep 27	2.4	2.3
	MEAN	2.91	3.95
	STANDARD DEVIATION	0.73	2.53
Bobs West Basin	Sep 13	3.6	3.4
	Sep 13	3.2	3.3
	Sep 27	2.7	6.0
	Sep 27	2.7	5.9
	Oct 12	3.6	1.3
	Oct 12	3.5	1.7
	MEAN	3.22	3.6
	STANDARD DEVIATION	0.43	2.0

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
13. Boulter	Aug 19	3.6	1.3
	Aug 30	3.3	1.2
	Sep 7	3.6	1.5
	MEAN	3.5	1.33
	STANDARD DEVIATION	0.17	0.15
14. Brule	Jun 7	8.1	1.1
	Jun 18	7.0	1.5
	Jun 25	7.7	1.1
	Jul 8	7.4	0.9
	Jul 22	7.1	0.8
	Jul 23	7.1	0.8
	Aug 1	7.6	0.6
	Aug 4	7.1	0.8
	Aug 26	7.7	1.6
	Aug 27	7.4	1.4
	Sep 6	7.0	1.0
	Sep 25	6.4	2.4
	MEAN	7.3	1.17
	STANDARD DEVIATION	0.45	0.50
15. Buck	May 3	4.1	1.7
North Bay	May 14	3.8	1.6
North End	May 18	3.7	2.5
	May 26	4.0	1.8
	May 30	4.3	2.1
	Jun 1	5.8	2.3
	Jun 2	5.8	3.0
	Jul 1	4.0	2.6
	Jul 12	4.3	2.6
	Jul 19	4.0	1.4
	Jul 19	4.6	3.0
	Jul 26	3.6	1.5
	Jul 29	3.6	2.4
	Aug 5	3.6	0.7
	Aug 18	7.3	0.3
	Aug 20	3.3	2.5
	Aug 23	4.3	3.1
	Aug 26	3.0	3.3
	Sep 6	3.9	2.7
	Sep 16	3.3	--
	MEAN	4.22	2.16
	STANDARD DEVIATION	1.02	0.81

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
Buck	Aug 10	4.0	3.9
North Bay	Sep 19	3.9	4.2
South End	Oct 14	4.1	4.8
	Oct 24	4.3	3.6
	MEAN	4.07	2.42
	STANDARD DEVIATION	1.09	1.08
Buck	May 26	5.2	2.4
North Bay	Jun 16	4.6	2.0
#3	Jun 27	4.9	4.1
	Jul 9	4.3	2.0
	Jul 17	4.3	1.6
	Jul 26	3.6	1.7
	Aug 3	3.5	2.4
	Aug 27	3.2	3.5
	Sep 16	3.8	3.9
	Sep 29	3.5	4.4
	Oct 12	3.6	5.4
	MEAN	4.05	3.04
	STANDARD DEVIATION	0.65	1.28
16. Buckshot	Jul 12	4.3	1.7
	Jul 26	4.6	1.0
	MEAN	4.45	1.35
	STANDARD DEVIATION	0.21	0.49
17. Burridge	May 24	6.1	1.4
	Jun 7	5.2	2.6
	Jun 14	5.5	1.6
	Jun 21	4.9	1.4
	Jun 29	4.3	1.9
	Jul 5	4.4	2.0
	Jul 12	4.0	2.5
	Jul 19	3.3	1.2
	Jul 26	3.6	0.9
	Aug 3	4.0	1.6
	Aug 10	5.3	1.1
	Aug 16	4.0	1.5
	Aug 31	4.7	1.0
	Sep 6	3.9	1.4
	Sep 13	3.3	1.4
	Sep 20	3.0	2.6
	Sep 28	3.6	1.9
	Oct 12	5.2	1.0
	Oct 17	5.2	3.6
	Nov 4	5.2	1.8
	MEAN	4.4	1.7
	STANDARD DEVIATION	0.86	0.68

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL *a* (ug/1)
18. Carson	Jun 10	5.8	2.1
	Jun 24	5.6	1.2
	Jul 7	6.4	1.4
	Jun 17	6.1	1.5
	Jul 2	5.2	1.5
	Jul 15	5.9	1.0
	Jul 22	5.2	1.2
	Aug 4	6.1	1.4
	Aug 12	5.5	1.5
	Aug 19	6.2	1.1
	MEAN	5.8	1.39
	STANDARD DEVIATION	0.42	0.31
19. Cashel	May 18	5.5	2.5
	May 18	5.8	1.9
	Jun 7	6.0	1.2
	Jun 7	6.6	0.9
	Jul 5	5.0	2.2
	Jul 5	5.2	2.3
	MEAN	5.68	1.38
	STANDARD DEVIATION	0.58	0.64
20. Charleston Big Waters	May 19	3.7	1.9
	Jun 21	3.3	4.2
	Jun 28	3.7	4.7
	Jul 5	3.7	5.9
	Jul 12	3.0	3.8
	Jul 19	3.8	--
	Jul 27	4.3	2.4
	Aug 4	3.6	4.3
	Aug 10	7.3	5.6
	Aug 17	3.3	4.1
	Aug 24	3.4	--
	Aug 31	3.3	4.0
	Sep 10	3.0	5.2
	Sep 14	3.3	3.8
	Sep 21	3.3	2.0
	Sep 29	4.3	3.6
	Oct 5	4.1	3.0
	MEAN	3.79	3.90
	STANDARD DEVIATION	0.99	1.20

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
Charleston Deep Waters	May 19	4.3	1.8
	May 31	3.5	3.8
	May 31	3.7	4.1
	Jun 8	3.0	4.9
	Jun 14	3.0	4.5
	Jun 14	3.0	5.4
	Jun 19	3.0	3.7
	Jun 21	4.3	3.8
	Jun 28	4.0	5.0
	Jul 5	4.3	6.3
	Jul 12	3.8	5.3
	Jul 19	3.3	4.6
	Jul 27	3.6	5.1
	Aug 4	3.5	4.8
	Aug 10	3.6	5.1
	Aug 17	3.8	4.2
	Aug 24	3.1	3.9
	Aug 31	3.3	2.9
	Sep 10	3.3	5.7
	Sep 14	3.3	4.0
	Sep 21	3.5	2.0
	Sep 29	4.3	3.5
	Oct 5	3.9	2.7
	MEAN	3.58	4.22
	STANDARD DEVIATION	0.45	1.14
Charleston Goose Island	Aug 3	3.6	4.0
	Aug 10	3.8	4.0
	Aug 17	4.3	3.6
	Aug 24	4.1	2.8
	Aug 30	3.2	3.6
	Sep 6	3.3	2.2
	Sep 13	3.2	2.9
	MEAN	3.64	3.3
	STANDARD DEVIATION	0.44	0.68
Charleston Webster Bay	Aug 10	4.3	4.4
	Aug 17	4.3	4.3
	Aug 24	4.1	3.6
	Aug 30	3.2	2.9
	Sep 6	3.2	2.9
	Sep 13	3.3	3.2
	Sep 28	3.8	3.2
	MEAN	3.74	3.5
	STANDARD DEVIATION	0.51	0.63

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
Charleston Western Water	Aug 10	4.3	4.5
	Aug 17	4.3	4.1
	Aug 24	4.1	4.1
	Aug 30	3.2	3.0
	Sep 6	3.2	3.5
	Sep 13	3.6	3.4
	Sep 28	3.8	3.1
	MEAN	3.79	3.67
	STANDARD DEVIATION	0.47	0.57
21. Chippego	Apr 4	2.7	9.2
	Apr 11	2.7	3.9
	Apr 26	2.6	2.2
	May 9	2.6	3.0
	May 18	3.1	9.0
	May 25	3.0	10.0
	May 31	2.9	5.9
	Jun 14	2.4	3.8
	Jun 21	2.7	9.6
	Jul 5	2.6	6.6
	Jul 12	2.6	4.6
	Jul 19	2.7	5.3
	Aug 4	3.3	4.1
	Aug 9	3.3	4.3
	Aug 16	3.0	3.2
	Aug 29	3.6	3.3
	Sep 7	3.0	3.4
	Sep 17	3.0	3.4
	Sep 27	3.3	3.5
	Oct 17	3.3	5.4
	Nov 8	3.0	2.9
	MEAN	3.2	3.65
	STANDARD DEVIATION	0.24	0.88
22. Christie	Jun 28	4.8	1.6
	Jul 19	3.1	1.2
	Aug 16	3.5	2.3
	Sep 6	3.0	1.5
	Oct 4	2.9	5.1
	Nov 1	3.0	7.7
	MEAN	3.38	3.23
	STANDARD DEVIATION	0.73	2.61

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
23. Clayton	Jul 5	4.0	2.0
	Jul 13	3.5	1.2
	Jul 20	3.6	2.3
	Jul 27	3.6	2.0
	Aug 4	3.6	1.5
	Aug 10	4.0	3.7
	Aug 19	3.3	3.3
	Sep 13	3.0	4.0
	Sep 20	3.5	7.1
	Oct 4	4.6	3.1
	MEAN	3.67	3.02
	STANDARD DEVIATION	0.44	1.71
24. Clear	Aug 1	3.0	1.5
25. Clyde	May	3.7	1.1
	Jul 19	3.5	--
	Jun 28	3.7	4.2
	Sep 20	2.2	4.2
	MEAN	3.28	3.17
	STANDARD DEVIATION	0.72	1.79
25. Colton	Jun 7	5.9	2.4
	Jun 10	5.3	1.9
	Jun 20	4.7	1.2
	Jun 25	5.5	1.3
	Jul 2	6.4	1.6
	Jul 5	7.8	1.6
	Jul 8	7.8	0.8
	Jul 15	6.4	0.6
	Jul 23	7.0	0.3
	Aug 21	7.9	0.5
	Sep 13	6.4	0.6
	Oct 12	7.9	1.4
	MEAN	6.58	1.18
	STANDARD DEVIATION	1.11	0.64
27. Constan	May 29	3.7	1.6
	Jun 14	4.3	2.1
	Jun 25	4.0	1.3
	Jul 2	4.0	2.6
	Jul 6	4.6	2.0
	Jul 17	4.3	--
	Jul 25	4.9	1.2
	Jul 30	4.9	1.0
	Aug 6	4.6	1.4
	Aug 14	4.6	1.4
	Aug 21	5.5	1.0
	Sep 8	4.6	1.8
	MEAN	4.5	1.58
	STANDARD DEVIATION	0.48	0.50

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
28. Cranberry	Jul 2	3.1	3.5
	Jul 16	1.9	3.6
	Jul 23	2.1	11.0
	Aug 4	2.6	3.3
	Aug 19	3.0	4.2
	Aug 26	2.6	4.5
	Sep 1	2.9	4.9
	Sep 19	3.3	2.8
	MEAN	2.70	4.73
	STANDARD DEVIATION	0.47	2.63
29. Crosby	May 10	4.0	1.7
	May 24	5.2	3.2
	May 31	4.3	9.3
	Jun 7	4.9	2.6
	Jul 5	4.3	1.5
	Jul 12	5.2	3.1
	Jul 19	4.0	0.9
	Jul 28	4.3	1.8
	Jul 28	4.6	1.5
	Aug 7	4.3	2.1
	Aug 18	3.6	1.1
	Aug 23	3.9	1.0
	Sep 13	3.9	2.4
	MEAN	4.35	2.48
	STANDARD DEVIATION	0.50	2.18
30. Crow	Jun 14	5.0	2.9
	Aug 19	4.6	2.0
	Aug 19	4.9	2.1
	Aug 19	4.9	1.4
	Aug 26	3.8	0.9
	Aug 26	3.8	0.9
	Aug 30	4.9	0.7
	Aug 30	4.9	0.8
	Sep 2	4.1	1.2
	Sep 9	3.3	2.1
	Sep 21	3.2	2.5
	Sep 29	3.3	2.8
	MEAN	4.23	1.69
	STANDARD DEVIATION	0.72	0.81

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
31. Crowe	Jun 14	3.0	2.3
	Jun 21	1.8	2.9
	Jun 28	2.7	1.9
	Jul 5	3.0	1.6
	Jul 12	2.9	2.9
	Jul 19	3.0	2.3
	Jul 26	2.9	1.8
	Aug 3	2.7	1.6
	Aug 9	2.9	1.7
	Aug 17	2.4	1.7
	Aug 23	3.3	1.7
	Aug 30	2.6	1.0
	Sep 7	3.5	1.3
	Sep 13	3.2	3.3
	MEAN	2.85	2.0
	STANDARD DEVIATION	0.41	0.66
32. Dalhousie #1	Jul 13	5.8	0.8
	Jul 20	5.8	0.7
	Aug 2	4.0	0.6
	Aug 7	4.6	0.9
	Aug 11	4.9	0.8
	Aug 18	4.9	1.1
	Sep 1	6.4	1.3
	Sep 11	--	--
	MEAN	5.21	0.89
	STANDARD DEVIATION	0.83	0.24
Dalhousie #2	Aug 3	5.8	1.3
	Aug 9	6.4	1.4
	Aug 18	5.5	1.7
	Aug 23	3.3	1.4
	Aug 31	5.8	1.0
	MEAN	5.36	1.36
	STANDARD DEVIATION	1.20	0.25
Dalhousie #3	Jun 28	3.7	2.3
	Jul 19	5.5	2.1
	Aug 9	4.6	2.3
	Aug 23	4.1	1.5
	MEAN	4.48	2.05
	STANDARD DEVIATION	0.78	0.38

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
33. Desert #1	May 27	4.7	2.7
	Jun 12	4.4	8.0
	Jul 1	4.2	2.1
	Jul 12	5.7	1.7
	Jul 26	5.0	1.2
	Aug 7	4.6	1.3
	Aug 19	4.1	1.7
	Aug 30	4.3	1.5
	Sep 13	4.4	2.1
	Sep 25	3.8	1.9
	MEAN	4.52	2.42
	STANDARD DEVIATION	0.53	2.01
Desert #2	May 18	4.1	3.8
	Oct 10	4.4	2.5
	MEAN	4.25	3.15
	STANDARD DEVIATION	0.21	0.92
Desert #3 South	May 19	3.7	1.3
	Jun 7	5.3	3.3
	May 31	5.0	2.2
	Jun 21	4.6	1.6
	Aug 5	5.0	1.8
	Aug 13	5.0	1.3
	Aug 25	4.3	2.0
	MEAN	4.7	1.93
	STANDARD DEVIATION	0.55	0.69
34. Devil A	Jul 12	5.7	1.9
	Jul 19	5.2	1.5
	Jul 28	4.9	1.3
	Aug 2	5.2	1.7
	Aug 9	4.7	1.9
	Aug 22	5.2	1.8
	Sep 4	4.6	1.5
	Sep 13	4.4	2.1
	Sep 20	3.9	--
	Sep 27	3.8	4.2
	MEAN	4.76	1.99
	STANDARD DEVIATION	0.61	0.87

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
Devil B	Jul 12	4.9	1.6
	Jul 19	6.1	2.2
	Jul 28	5.5	1.4
	Aug 2	5.5	1.5
	Aug 9	5.2	2.0
	Aug 22	5.3	1.8
	Sep 4	5.0	1.5
	Sep 13	4.9	1.6
	Sep 20	4.7	--
	Sep 27	4.4	3.8
	MEAN	5.15	1.93
	STANDARD DEVIATION	0.48	0.75
35. Diamond	Jun 28	4.9	1.2
	Jul 6	4.9	1.0
	Aug 3	4.3	1.0
	Aug 10	7.9	1.0
	Aug 16	4.9	0.8
	Aug 23	4.9	0.8
	MEAN	5.3	0.97
	STANDARD DEVIATION	1.30	0.15
36. Dickey South	May 24	5.7	1.4
	Jul 15	4.3	1.8
	Jul 5	4.6	1.8
	Jul 12	4.2	1.6
	Jul 12	4.2	1.6
	Jul 19	5.7	1.2
	Jul 26	5.3	1.0
	Aug 3	6.4	0.9
	Aug 9	5.6	0.7
	Aug 17	6.5	0.9
	Aug 24	5.3	1.2
	Aug 28	6.4	0.6
	Oct 11	6.1	1.4
	MEAN	5.41	1.24
	STANDARD DEVIATION	0.85	0.40

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
Dickey North	Apr 19	3.9	0.9
	May 24	4.2	1.5
	Jun 15	4.1	1.6
	Jul 5	9.5	1.5
	Jul 12	4.9	1.6
	Jul 19	4.8	1.3
	Jul 26	4.5	1.1
	Aug 3	5.2	0.9
	Aug 9	4.9	1.0
	Aug 17	4.9	0.9
	Aug 24	5.3	1.4
	Aug 28	5.7	0.6
	Oct 11	5.1	2.6
	MEAN	5.23	1.3
	STANDARD DEVIATION	1.41	0.50
37. Dore	Jun 28	5.9	1.5
	Jul 15	5.8	0.9
	Aug 14	4.4	2.3
	Aug 20	4.3	2.9
	Sep 25	3.6	--
	Oct 12	4.1	4.2
	MEAN	4.68	2.36
	STANDARD DEVIATION	0.95	1.28
38. Eagle #1	May 31	4.4	2.9
	Jun 7	4.5	1.8
	Jun 15	5.2	2.7
	Jun 20	4.3	1.6
	Jun 27	4.7	2.0
	Jul 5	4.0	2.2
	Jul 10	4.7	3.1
	Jul 12	4.7	2.8
	Jul 25	4.6	1.6
	Aug 9	3.6	1.7
	Aug 23	5.0	1.7
	Aug 31	4.4	1.5
	Sep 12	3.2	1.9
	MEAN	4.41	2.12
	STANDARD DEVIATION	0.56	0.56

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
Eagle #2	May 18	3.8	3.1
	May 24	4.4	1.3
	May 31	4.7	2.2
	Jun 7	5.3	2.4
	Jun 21	5.3	2.3
	Jun 29	4.7	1.5
	Jul 5	4.7	2.2
	Jul 19	4.7	1.4
	Jul 26	4.7	1.3
	Aug 3	4.7	1.5
	Aug 10	5.0	1.7
	Aug 16	4.4	1.6
	Aug 23	5.6	2.0
	Aug 30	5.3	1.6
	Sep 13	4.4	2.9
	Sep 20	4.1	3.0
	MEAN	4.74	2.0
	STANDARD DEVIATION	0.47	0.61
39. Farren	May 18	4.3	1.2
	May 24	5.3	1.2
	May 31	6.1	1.8
	Jun 7	6.6	2.3
	Jun 14	5.8	1.6
	Jun 21	6.4	1.7
	Jun 28	6.4	1.4
	Jul 5	5.9	2.0
	Jul 12	6.0	1.9
	Jul 26	5.0	1.8
	Aug 2	5.5	1.2
	Aug 9	11.2	1.4
	Aug 16	5.0	1.5
	Aug 23	5.6	1.8
	Aug 30	5.2	1.1
	Sep 7	4.9	1.0
	Sep 13	4.1	1.3
	Sep 20	4.6	2.6
	Oct 4	5.5	1.7
	Oct 12	3.6	1.2
	MEAN	5.65	1.59
	STANDARD DEVIATION	1.53	0.42
40. Fifth Depot	Jun 7	3.8	1.7
	Jun 28	3.7	2.7
	Jul 12	3.3	4.5
	Jul 22	4.3	3.3
	Aug 16	2.1	3.6
	Aug 23	3.3	4.9
	MEAN	3.42	3.45
	STANDARD DEVIATION	0.75	1.17

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
41. Flower Round	May 24	4.0	1.8
	Jun 28	4.6	5.7
	Jul 19	3.6	1.8
	Sep 20	2.7	2.4
	MEAN	3.73	2.93
	STANDARD DEVIATON	0.80	1.87
42. Gananoque	Jun 14	3.0	3.5
	Jun 21	3.1	4.4
	Jul 2	2.7	5.0
	Jul 12	3.0	5.2
	Jul 26	5.5	5.3
	Aug 4	5.5	6.6
	Aug 23	6.7	4.3
	Sep 4	3.0	4.6
	Sep 12	3.0	3.9
	Sep 20	3.2	2.0
	Sep 27	3.0	5.7
	Oct 1	2.9	4.2
	MEAN	3.72	4.56
	STANDARD DEVIATION	1.35	1.17
43. Glanmire	Aug 23	6.1	4.2
	Aug 30	3.3	1.5
	Sep 13	1.8	8.9
	Sep 27	1.5	12.2
	Oct 4	1.8	7.0
	Oct 25	2.4	2.5
	MEAN	2.82	6.05
	STANDARD DEVIATION	1.73	4.09
44. Golden	Jul 5	3.1	2.6
	Sep 7	3.9	2.1
	MEAN	3.5	2.35
	STANDARD DEVIATION	0.57	0.35
45. Green	May 31	7.9	1.5
	Jun 7	7.8	1.0
	Jun 21	9.1	1.7
	Jun 14	8.7	1.2
	Jun 28	11.1	2.9
	Jul 5	11.1	1.6
	Jul 19	11.4	1.2
	Aug 23	11.4	1.1
	MEAN	9.81	1.51
	STANDARD DEVIATION	1.60	0.57

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL *a* (ug/l)
46. Grippen	May 17	2.1	11.0
	May 24	2.4	9.8
	Jun 2	2.3	7.4
	Jun 11	1.7	8.5
	Jul 13	5.2	5.3
	Jul 27	5.0	4.0
	Aug 13	2.7	4.3
	Aug 24	1.1	4.1
	Sep 1	1.8	4.2
	Sep 20	4.3	4.8
	Oct 5	2.9	4.6
	Oct 19	3.5	2.3
	MEAN	2.92	5.86
	STANDARD DEVIATION	1.32	2.68
47. Gunter A	Jun 7	3.1	3.3
	Jun 28	3.1	2.1
	Jul 22	4.4	1.2
	Aug 3	4.4	1.1
	Aug 19	9.4	1.7
	Sep 23	4.1	1.8
	Oct 12	2.9	4.6
	Nov 7	3.8	2.7
	MEAN	4.4	2.31
	STANDARD DEVIATION	2.11	1.18
Gunter B	Jun 7	3.9	3.5
	Jun 28	3.7	2.2
	Jul 22	4.0	1.8
	Aug 3	4.1	2.4
	Aug 19	8.8	4.5
	Sep 23	2.9	2.5
	Oct 12	2.9	3.4
	Nov 7	3.9	1.9
	MEAN	4.28	2.78
	STANDARD DEVIATION	1.89	0.94
48. Hambley	Jun 1	4.0	2.4
	Jun 19	4.0	2.1
	Jul 2	4.0	2.2
	Aug 6	4.3	3.5
	MEAN	4.08	2.55
	STANDARD DEVIATION	0.15	0.65

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
49. Hay Bay	Apr 13	1.8	10.0
	Apr 22	1.4	16.0
	May 3	1.5	9.2
	May 4	1.8	6.8
	May 20	.9	14.0
	May 22	1.8	8.7
	Jun 2	1.7	6.7
	Jun 7	1.2	12.0
	Jun 12	1.2	4.4
	Jun 30	1.4	14.0
	Jul 30	1.4	24
	Aug 10	1.4	21
	Aug 19	1.2	16
	Aug 26	1.4	14.0
	Sep 15	1.2	25
	Nov 4	1.4	25.
	MEAN	1.42	14.18
	STANDARD DEVIATION	0.26	6.67
50. Hungry	Sep 13	3.0	2.8
	Oct 12	3.3	4.8
	MEAN	3.15	3.8
	STANDARD DEVIATION	0.21	1.41
51. Joeperry	Jun 23	3.0	2.3
	Jul 8	3.6	1.9
	Jul 23	4.6	1.8
	Aug 6	9.1	1.0
	Aug 21		1.3
	Sep 3	7.6	1.7
	MEAN	5.58	1.67
	STANDARD DEVIATION	2.65	0.46
52. Kennebec A East	May 24	2.8	2.1
	Jun 7	3.2	2.2
	Jun 28	3.2	2.0
	Jul 5	3.6	2.0
	Jul 16	3.7	0.8
	Jul 26	3.4	1.5
	Aug 9	3.2	3.3
	Sep 1	3.9	1.1
	Sep 21	2.7	1.9
	Oct 4	3.2	2.4
	MEAN	3.3	1.93
	STANDARD DEVIATION	0.38	0.70

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
Kennebec B West	May 24	3.1	2.1
	Jun 7	3.2	2.0
	Jun 7	2.7	2.9
	Jun 21	2.4	4.8
	Jun 28	3.3	2.4
	Jul 5	3.3	2.1
	Jul 16	3.6	0.8
	Jul 26	3.3	2.5
	Aug 9	3.3	3.0
	Aug 16	5.8	3.6
	Aug 30	2.7	1.9
	Sep 1	4.0	0.9
	Sep 13	2.4	2.2
	Sep 21	2.7	1.5
	Sep 27	2.1	3.3
	Oct 4	3.2	2.2
	Oct 12	2.1	2.9
	MEAN	3.1	2.4
	STANDARD DEVIATION	0.87	0.97
53. Limerick	May 18	3.0	2.3
	Jun 17	4.3	0.7
	Aug 14	4.9	1.5
	Aug 21	5.5	1.1
	Sep 9	4.3	1.0
	MEAN	4.4	1.32
	STANDARD DEVIATION	0.93	0.62
54. Loughborough East Basin	Jun 23	2.4	5.3
	Jul 6	3.7	3.5
	Jul 12	7.6	2.5
	Jul 14	2.6	4.8
	Jul 21	2.1	5.3
	Jul 30	2.1	6.7
	Aug 5	2.4	5.1
	Aug 12	2.3	6.3
	Aug 20	2.4	4.8
	Aug 27	2.3	4.3
	Sep 3	2.1	4.7
	MEAN	2.91	4.85
	STANDARD DEVIATION	1.62	1.17
Loughborough West Basin	Jul 19	7.6	1.6
	Aug 3	6.4	--
	Aug 12	6.8	3.4
	Aug 23	6.7	3.3
	Sep 7	7.3	1.8
	Oct 17	5.8	3.3
	MEAN	6.77	2.68
	STANDARD DEVIATION	0.64	0.90

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
55. Lower Beverley	Jun 7	2.3	--
	Jun 14	2.4	5.3
	Jun 21	2.4	4.8
	Jun 28	2.2	5.5
	Jul 5	2.3	7.7
	Jul 12	2.0	7.5
	Jul 19	2.0	6.4
	Sep 7	1.9	7.8
	MEAN	2.49	6.43
	STANDARD DEVIATION	0.20	1.25
56. Mackie	Jun 7	4.9	3.3
	Jun 29	5.9	1.1
	Jul 20	6.4	1.4
	Jul 28	--	2.1
	Aug 14	5.9	1.8
	Aug 23	7.0	3.0
	Aug 31	5.9	1.9
	Sep 13	6.4	3.6
	MEAN	6.06	2.28
	STANDARD DEVIATION	0.65	0.92
57. Mazinaw Upper Basin	Jun 23	3.0	1.6
	Jul 6	4.6	1.0
	Jul 8	4.6	1.5
	Jul 23	4.9	1.2
	Aug 6	5.2	1.4
	Aug 21	--	1.6
	Sep 3	5.8	0.9
	MEAN	4.68	1.31
	STANDARD DEVIATION	0.94	0.29
Mazinaw Lower Basin	Jul 29	4.9	0.7
	Aug 9	5.9	1.3
	MEAN	5.4	1.0
	STANDARD DEVIATION	0.71	0.42
58. Mephisto	May 31	5.5	1.6
	Jun 21	5.9	0.8
	Aug 30	4.9	0.8
	Oct 12	5.5	1.5
	Oct 31	5.0	1.0
	MEAN	5.36	1.14
	STANDARD DEVIATION	0.41	0.38

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
59. Millers	Jul 28	3.6	2.1
60. Mink	Aug 4	3.6	1.8
	Aug 10	3.3	2.7
	Aug 18	3.1	2.5
	Sep 1	1.7	1.6
	Sep 15	3.0	1.4
	Oct 12	3.5	4.7
	MEAN	3.03	2.45
	STANDARD DEVIATION	0.69	1.21
61. Mississippi Big Lake	Jun 29	3.2	2.7
	Jul 5	3.2	2.7
	Jul 13	2.9	--
	Jul 24	2.9	2.9
	Jul 27	2.1	7.7
	Aug 4	2.0	14
	Aug 18	2.9	7.5
	Aug 18	2.9	--
	Aug 23	3.5	2.1
	Aug 23	3.5	--
	Sep 19	3.2	2.6
	Oct 12	2.4	3.9
	MEAN	2.89	5.12
	STANDARD DEVIATION	0.49	3.95
Mississippi Third Lake	Jun 21	1.8	3.2
	Jun 16	2.2	3.4
	Jun 29	3.1	2.7
	Jul 7	2.1	1.8
	Jul 15	2.7	2.3
	Jul 22	1.7	2.8
	Jul 27	2.0	12.0
	Aug 4	1.8	7.5
	Aug 10	2.1	4.9
	Aug 24	2.1	4.7
	Sep 1	2.1	6.5
	Sep 7	2.1	3.4
	MEAN	2.15	4.6
	STANDARD DEVIATION	0.39	2.89
62. Moira	Apr 19	2.2	14.0
	May 3	3.2	5.7
	May 17	2.7	3.7
	May 31	4.3	2.0
	Jun 28	3.1	3.6
	Jul 26	3.3	3.4
	Aug 9	3.0	3.3
	MEAN	3.13	5.1
	STANDARD DEVIATION	0.62	4.07

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
63. Mosque #1	May 17	5.8	2.5
	Jun 6	5.8	1.4
	Jun 28	5.5	1.7
	Jul 11	5.5	1.1
	Aug 3	5.5	1.3
	Aug 21	6.4	0.9
	Sep 6	6.4	1.1
	Oct 9	5.5	2.4
	MEAN	5.8	1.6
	STANDARD DEVIATION	0.39	0.60
Mosque #2	May 17	5.5	1.1
	Jun 6	5.5	3.0
	Jun 28	3.7	1.3
	Jul 11	5.5	1.6
	Aug 3	5.2	0.9
	Aug 21	6.4	--
	Sep 6	5.2	1.2
	Oct 9	5.5	2.2
	MEAN	5.3	1.6
	STANDARD DEVIATION	0.75	0.74
Mosque #3	May 17	4.0	1.0
	Jun 6	4.0	1.5
	Jun 28	5.5	1.7
	Jul 11	4.5	0.7
	Aug 3	4.6	1.3
	Aug 21	5.2	2.0
	Sep 6	4.6	2.3
	Oct 9	3.9	3.1
	MEAN	4.5	1.7
	STANDARD DEVIATION	0.58	0.77
64. Mud	Jun 14	4.7	2.6
65. Muskrat	May 19	2.0	9.8
	May 27	1.2	4.9
	Jun 2	1.4	3.6
	Jun 18	1.7	5.7
	Jun 24	1.5	8.7
	Jul 2	2.4	7.0
	Jul 7	2.1	4.0
	Jul 21	2.4	4.8
	Jul 28	2.1	8.8
	Aug 4	1.1	45
	Aug 11	1.1	53
	Aug 19	0.9	71
	Aug 28	1.4	29
	MEAN	1.64	19.64
	STANDARD DEVIATION	0.51	22.56

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
66. Newboro	May 31	2.59	--
	Jun 13	3.0	6.3
	Jun 21	2.5	5.0
	Jul 4	2.6	3.0
	Jul 26	2.0	5.8
	Aug 9	2.3	6.4
	Aug 30	3.2	2.4
	Sep 7	3.5	2.5
	MEAN	2.71	4.49
	STANDARD DEVIATION	0.49	1.80
67. Norway	Aug 30	5.3	0.7
	Sep 7	6.7	1.4
	Sep 13	4.6	1.4
	Sep 20	3.9	--
	Sep 27	4.9	0.6
	MEAN	5.08	1.03
	STANDARD DEVIATION	1.04	0.43
68. Olmstead	Jun 10	5.5	1.8
	Jun 21	5.5	1.8
	Jul 5	4.3	2.1
	Jul 19	4.3	1.7
	Aug 2	5.8	1.3
	Aug 20	8.2	0.9
	Sep 3	7.0	0.9
	Sep 19	5.5	1.4
	Oct 10	5.8	2.6
	Oct 24	4.9	5.8
	MEAN	5.68	2.03
	STANDARD DEVIATION	1.18	1.42
69. Opinicon #1	Jun 28	3.4	3.0
	Jul 5	3.4	1.8
	Jul 7	4.3	1.5
	Jul 17	3.5	4.5
	Jul 17	3.0	2.7
	Jul 19	3.0	2.6
	Jul 26	2.7	3.7
	Aug 2	3.3	3.7
	Aug 10	3.0	3.1
	Aug 16	3.0	4.8
	MEAN	3.26	3.14
	STANDARD DEVIATION	0.44	1.07

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
Opinicon #2	May 8	3.4	1.4
	May 31	3.8	1.3
	Jun 7	2.4	1.4
	May 24	4.8	6.3
	Jun 21	3.8	3.1
	Jun 29	3.4	3.3
	Jul 21	3.0	4.1
	Jul 28	3.0	2.9
	Aug 4	3.3	3.4
	Aug 10	3.2	3.4
	Aug 17	2.4	3.5
	Aug 24	2.9	3.6
	Sep 1	2.7	3.1
	Sep 9	2.4	3.1
	Oct 4	3.3	1.4
	Oct 14	3.9	4.1
	MEAN	3.2	3.09
	STANDARD DEVIATION	0.57	1.29
70. Otter #1	Jul 6	2.4	2.1
	Jul 13	2.7	2.1
	Aug 6	2.4	2.0
	Aug 10	2.4	2.3
	Aug 20	3.0	1.5
	Aug 26	2.9	2.5
	MEAN	2.63	2.08
	STANDARD DEVIATION	0.27	0.34
Otter #2	May 24	2.4	2.5
	May 31	2.6	2.9
	Jun 7	2.4	1.8
	Jun 20	2.4	2.1
	Jul 5	4.9	2.4
	Jul 5	5.2	2.0
	Jun 27	2.7	1.6
	Jul 19	3.0	1.4
	Jul 21	2.7	2.9
	Aug 2	2.1	2.3
	Aug 9	2.1	2.0
	Aug 22	2.6	1.5
	Aug 30	2.7	2.0
	Sep 19	3.0	2.8
	Oct 4	3.3	3.0
	MEAN	2.94	2.21
	STANDARD DEVIATION	0.97	0.53

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
71. Otty A	Jul 12	4.6	2.6
	Jul 19	4.6	1.7
	Jul 24	3.6	1.7
	Aug 4	3.5	1.4
	Aug 9	4.3	1.9
	Aug 23	3.6	2.0
	Aug 31	3.6	2.5
	Sep 7	4.3	2.1
	Sept 13	3.0	3.2
	N/A	3.3	2.4
	MEAN	3.8	2.2
	STANDARD DEVIATION	0.56	0.53
Otty B	Jul 12	4.9	3.0
	Jul 19	3.6	2.4
	Jul 24	4.0	1.3
	Aug 4	3.9	2.1
	Aug 9	--	1.8
	Aug 23	3.9	2.4
	Aug 31	3.0	2.4
	Sep 7	4.3	1.8
	Sep 13	3.9	3.2
	N/A	3.9	2.4
	MEAN	3.9	2.3
	STANDARD DEVIATION	0.51	0.57
72. Palmerston	May 23	4.6	0.9
	Jun 7	5.5	1.9
	Jun 14	8.5	0.9
	Jun 21	9.4	2.1
	Jun 28	9.4	1.2
	Jul 5	9.1	1.0
	Jul 19	8.2	0.7
	Jul 26	8.2	0.7
	Aug 3	8.2	0.9
	Aug 9	9.1	1.2
	Aug 23	8.5	1.1
	Aug 30	7.9	1.2
	MEAN	8.05	1.15
	STANDARD DEVIATION	1.5	0.44

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
73. Paugh	Jun 19	5.5	1.1
	Jun 28	5.2	0.9
	Jul 5	5.8	0.8
	Aug 4	4.9	1.4
	Aug 10	5.3	1.1
	Aug 21	4.9	1.2
	Sep 14	4.6	2.9
	Oct 4	4.7	1.0
	Oct 12	6.4	1.1
	Nov 29	5.3	1.7
	MEAN	5.26	1.32
	STANDARD DEVIATION	0.54	0.61
74. Pike #1	Jul 19	4.3	1.2
	Jul 31	4.3	1.7
	Aug 25	3.6	4.2
	Aug 29	2.7	3.9
	MEAN	3.73	2.75
	STANDARD DEVIATION	0.76	1.52
Pike #2	May 3	3.2	4.2
	May 4	2.7	1.4
	May 18	3.8	2.6
	May 24	4.9	1.7
	Jun 21	4.4	3.1
	Jun 28	4.4	2.8
	Jul 12	4.3	2.4
	Jul 19	4.4	2.7
	Aug 3	4.3	3.1
	Aug 23	3.6	5.5
	Sep 7	3.0	5.0
	Sep 20	2.7	5.4
	Oct 4	2.7	7.8
	Oct 17	3.0	6.9
	MEAN	3.67	3.9
	STANDARD DEVIATION	0.77	1.95
75. Potspoon	May 4	2.7	1.4
	May 20	2.9	1.2
	May 26	2.1	1.6
	Jun 2	4.3	1.2
	Jun 23	7.3	1.3
	Jul 6	7.6	1.8
	Jul 14	5.5	2.1
	Jul 30	4.3	1.1
	Aug 14	3.3	1.9
	Aug 25	3.6	2.1
	Sep 14	3.3	2.4
	Oct 16	3.0	2.0
	MEAN	4.16	1.68
	STANDARD DEVIATION	1.77	0.43

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
76. Redhorse	May 18	2.7	4.6
	May 31	3.1	4.8
	Jun 7	3.4	4.7
	Jun 21	3.8	5.9
	Jun 29	3.7	3.9
	Jul 7	3.7	5.5
	Jul 19	3.3	6.4
	Jul 28	3.2	4.9
	Aug 5	3.3	6.4
	Aug 23	3.0	5.4
	Aug 30	3.8	2.7
	MEAN	3.36	5.02
	STANDARD DEVIATION	0.36	1.09
77. Robertson	Jun 25	5.6	0.9
	Jun 30	5.8	1.2
	Jul 15	7.3	1.1
	Jul 24	7.6	--
	Jul 30	7.4	0.4
	Aug 14	7.4	0.7
	Aug 19	6.4	1.3
	Aug 26	6.4	1.1
	Oct 13	6.4	0.9
	MEAN	6.70	0.95
	STANDARD DEVIATION	0.75	0.29
78. St.Andrews	May 31	1.7	8.0
	Jun 6	1.7	5.2
	Jun 14	1.7	6.8
	Jun 28	1.7	8.7
	Jul 5	1.7	7.3
	Jul 12	1.7	7.2
	Jul 22	1.4	11.0
	Jul 28	3.5	8.3
	Aug 3	1.4	8.0
	Aug 10	1.4	8.6
	Aug 23	1.4	9.1
	Sep 20	1.2	10.1
	MEAN	1.71	8.19
	STANDARD DEVIATION	0.59	1.52
79. Salmon Trout	May 18	3.1	2.3
	May 24	2.7	1.0
	Jul 27	3.6	--
	Aug 10	3.6	9.0
	Aug 23	4.6	--
	Aug 30	3.3	3.6
	Sep 13	3.5	4.1
	Oct 12	3.6	2.2
	MEAN	3.5	3.7
	STANDARD DEVIATION	0.55	2.82

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
80. Shabomeka	Jul 2	3.9	2.3
	Jul 9	4.1	2.6
	Jul 16	4.4	1.4
	Jul 22	4.7	1.9
	Jul 30	4.9	2.3
	Aug 27	4.4	1.9
	MEAN	4.4	2.07
	STANDARD DEVIATION	0.37	0.42
81. Sharbot East Basin Hawley Bay	May 31	4.1	1.7
	Jun 7	4.3	2.9
	Jun 13	3.5	3.3
	Aug 22	4.6	1.7
	Aug 31	3.6	1.5
	MEAN	4.0	2.2
	STANDARD DEVIATION	0.5	0.8
Sharbot West Basin	Jun 24	4.0	3.1
	Jul 9	4.3	2.2
	Jul 23	5.2	1.9
	Aug 6	5.2	2.2
	Aug 20	4.3	1.6
	Sep 3	4.9	1.6
	MEAN	4.65	2.1
	STANDARD DEVIATION	0.52	0.56
82. Silver	May 26	4.0	2.2
	Jun 7	3.6	2.1
	Jun 14	3.7	2.3
	Jun 21	3.1	2.9
	Jun 21	3.1	1.1
	Jul 5	3.8	2.3
	Jul 12	3.3	2.2
	Jul 19	3.2	2.0
	Jul 28	4.2	1.7
	Aug 2	3.9	1.6
	Aug 10	3.3	2.3
	Aug 17	3.2	1.9
	Aug 22	4.1	1.5
	Aug 31	3.4	1.8
	Sep 8	3.6	1.4
	Sep 13	3.0	2.4
	Sep 20	3.6	--
	Oct 9	4.2	2.5
	MEAN	3.57	2.01
	STANDARD DEVIATION	0.40	0.45

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
83. Smith	Jul 1	4.1	3.2
	Jul	3.8	3.0
	Jul 5	4.1	4.1
	Jul 18	3.9	3.1
	Jul 24	7.1	3.1
	Jul 30	3.3	3.2
	Aug 5	3.9	2.9
	Aug 11	3.6	3.5
	Sep 20	3.3	2.6
	MEAN	4.1	3.2
	STANDARD DEVIATION	1.16	0.42
84. Spring	Jun 1	6.1	2.1
	Jun 19	8.8	1.1
	MEAN	7.45	1.6
	STANDARD DEVIATION	1.91	0.71
85. Spruce	Jun 7	4.6	1.0
86. Sunday	Jun 14	4.0	1.5
87. Troy	Apr 2	2.7	3.8
	May 2	3.7	2.4
	May 24	5.5	1.7
	Jun 7	--	--
	Jun 14	3.2	3.9
	Jul	3.6	3.5
	Jun 21	2.6	4.7
	Jun 28	2.4	4.4
	Jul 5	2.6	4.1
	Jul 12	3.5	5.0
	Jul 19	3.0	3.5
	Jul 26	2.7	5.1
	Aug 3	2.9	3.0
	Aug 9	2.8	4.7
	Aug 23	2.6	2.5
	Aug 30	2.4	2.0
	Sep 7	2.4	4.4
	Sep 13	2.1	5.3
	Sep 20	2.1	6.3
	Nov 15	2.7	3.0
	MEAN	2.34	4.2
	STANDARD DEVIATION	0.25	1.73
88. Twin Sisters East Basin	Jul 2	3.7	--
	Jul 9	3.2	3.3
	MEAN	3.45	--
	STANDARD DEVIATION	0.35	--

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
Twin Sisters West Basin	Jul 1	--	1.2
	Jul 9	4.3	4.0
	Aug 22	4.9	0.4
	Aug 30	4.9	1.0
	Sep 7	4.9	2.4
	Sep 13	4.7	0.9
	Sep 20	4.3	1.1
	Oct 4	4.9	--
	Oct 13	3.8	4.2
	Oct 25	3.6	1.7
	Nov 1	3.3	2.0
	MEAN	4.36	1.89
	STANDARD DEVIATION	0.61	1.30
89. Verona	Jul 6	2.2	6.5
	Jul 13	2.7	8.1
	Aug 18	2.3	6.8
	MEAN	2.4	7.13
	STANDARD DEVIATION	0.26	2.0
90. Wallbridge	Jun 29	2.4	5.1
	Jun 14	1.2	5.5
	MEAN	1.8	5.3
	STANDARD DEVIATION	0.85	0.28
91. White #1	Jun 4	3.2	2.2
	Jun 10	3.2	--
	Jun 18	2.9	2.1
	Jun 25	2.9	2.4
	Jul 2	2.9	3.6
	Jul 10	2.7	2.5
	Jul 16	2.4	1.4
	Jul 24	2.4	2.5
	Jul 30	1.8	3.6
	Aug 6	1.8	3.5
	Aug 13	1.8	4.0
	Aug 21	2.1	3.5
	Aug 28	2.6	2.7
	Sep 3	2.1	3.5
	Sep 15	2.0	7.7
	Sep 23	2.3	5.1
	Oct 1	2.9	4.2
	Oct 15	3.6	2.1
	MEAN	2.5	3.3
	STANDARD DEVIATION	0.54	1.46

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
White #2	Jun 4	3.4	1.6
	Jun 10	4.9	3.3
	Jun 18	3.2	1.3
	Jun 25	3.2	2.0
	Jul 2	3.2	2.8
	Jul 10	4.0	2.1
	Jul 16	2.7	0.9
	Jul 24	2.4	--
	Jul 30	2.3	3.3
	Aug 6	2.0	2.9
	Aug 13	2.0	3.5
	Aug 21	2.0	4.2
	Aug 28	2.6	2.1
	Sep 3	2.0	3.6
	Sep 15	2.0	8.6
	Sep 23	2.4	5.5
	Oct 1	2.9	2.0
	Oct 15	3.0	3.1
	MEAN	2.8	3.1
	STANDARD DEVIATION	0.79	1.81
92. Wollaston	May 29	4.6	1.1
	Jun 24	4.9	1.4
	Aug 25	4.9	1.4
	MEAN	4.8	1.33
	STANDARD DEVIATION	0.17	0.21